Saskatchewan Agriculture and Food

Hemp Production in Saskatchewan

Introduction

Industrial hemp(*Cannabis sativa*) has been cultivated for centuries as a source of fibre for rope, sail and clothing, and the seed crushed for oil, food and feed. In Canada, hemp was outlawed in 1937 under the *Narcotics Control Act*. However, hemp varieties with low levels of delta-9 tetrahydrocannabinol (THC) have since been developed, and in March of 1998 the ban was lifted, permitting the production of hemp under license. Canada has adopted a THC level of 0.3 per cent as the concentration that separates non-narcotic from narcotic cultivars.

In 2004, 66,325 metric tonnes (MT) of hemp fibre and 30,265 MT of hemp seed were produced world wide. The major hemp fibre producers are China (26,000 MT), Spain, North Korea and Chile, while the major hemp grain growers are China (24,000 MT), France and Chile. Approximately 9,700 ha (24,000 ac.) of hemp was grown in Canada in 2005. In Saskatchewan, close to 3,430 ha (8,470 ac.) were seeded to hemp seed in 2005, with 87 growers receiving licenses to grow hemp. Hemp production in Saskatchewan is equally split between conventional and organic hemp. Almost all of the industrial hemp produced in Canada is for the seed market, as the fibre processing industry is still under development.

Hemp leaves.

Hemp is a tall (1.5 - 4 m or 4 - 13 ft.) annual plant grown for grain and fibre. In well-structured soils, the plant can produce a 15 to 30 cm (6 - 12 in.) tap root. In compacted or poorly drained soils, the plant produces more lateral fibrous roots. Leaves are palmate with seven to 11 leaflets having serrated edges.

Hemp is commonly dioecious (separate male and female plants). The male plants die after pollinating, causing uneven maturity and varying fibre quality. Plant breeders in Europe have developed monoecious (male and female flowers on the same plant) varieties which are more desirable for fibre production. The monoecious female trait must be maintained by strict roguing during pedigree seed production.

Female and male hemp plants in the field.

The outer portion of the hemp stem contains strong and long bast fibres which provide the strength and quality attributed to the crop. The inner portion of the stem contains the hurd, which is used for paper and building materials.

The grain contains an edible oil used for cosmetics and cooking. The oil is low in saturated fats and contains a mixture of omega-6 and omega-3 fatty acids, as well as gamma linolenic acid (GLA), a nutraceutical compound.

The bushel weight of hemp is 44 lb. with about 27,000 seeds per pound (60 seeds/g or 17 g/1,000 seeds).

Licensing

Hemp regulations are administered by Health Canada. Persons carrying out any activity involving hemp must be licensed. Possession of hemp plant parts or products without the appropriate license is a criminal offence. Exceptions are mature stalks without leaves, branches or flowers, and non-viable seeds. Licenses are issued for one calendar year for cultivating, importing, exporting, processing, distributing, possessing, plant breeding, analyzing, and sampling hemp.

License applications, guides and further details are available from Health Canada, Ottawa (see additional information).

For example, producers applying for a license to cultivate hemp require the following:

- Industrial Hemp License Application Form
- Schedule 1 - License to Cultivate Industrial Hemp
- Schedule 5 - License to Distribute Industrial Hemp
- Schedule 6 - Information on Officers, Directors and/or Partners (if corporation or partnership)
- Schedule 9- Authorization to Possess Industrial Hemp (if someone other than the person named in Schedule 1 is in possession)
- Global Positioning System (GPS) co-ordinates of the corners of the hemp production area; minimum four hectares (10 ac.) per set of co-ordinates
- Map of hemp production area showing recognizable landmarks and roads
- Name of hemp variety to be grown
- Police security check - supplied by local police

Note: Cultivation of hemp is not allowed within one kilometre of a place frequented by people less than 18 years of age (i.e. school). All seeding and harvesting equipment must be thoroughly cleaned before leaving the licensed hemp field. Records must be kept for a minimum of two years. Replanting of bin run seed is prohibited. Before a licence is issued, a criminal check and clearance through the RCMP would be conducted.

This information is provided as a guideline only. Contact Health Canada for detailed licensing requirements.

Market Opportunities

Markets for hemp are not well established, although in recent years there has been significant improvement. Interested producers are cautioned to investigate markets and

secure a contract before undertaking production. Approximately 10 companies were provided contracts for hemp seed production in 2005 in Canada. The grain market is developing faster than the fibre market in western Canada. The latter is practically non-existent, though some entrepreneurs have shown interest in setting up plants to use hemp fibre.

In 2005, the price for conventional hemp grain ranged from $0.45 to $0.60/lb., while certified organic hemp grain price ranged from $0.85 to $0.90/lb.

Adaptation

Hemp does well in a variety of soil types, but does not tolerate drought, flooding, saturated or saline soils. It is tolerant of light spring frosts. Tests show that hemp grows well in the Dark Brown to the thick Black soils of Saskatchewan with medium texture, high soil moisture and a long growing season. This is particularly true for Finola, a northern variety with a Russian/Finish origin. Hemp is not well suited for the southwest due to the drier conditions and heavy clay soils. In general, hemp is best suited to areas with moderate rainfall and good soil fertility.

Maturity varies from 80 to 120 days depending on variety and date of seeding. Hemp is a photosensitive plant, thus flowering of the plant is triggered by the shorter day lengths after June 21. Crops seeded in early spring may produce taller stalks and higher yields, but will not flower or mature much earlier than later seeded crops. Hemp should be seeded between May 1 and May 31, with May 15 being the optimum seeding date. Since hemp is sensitive to day length, late seeded crops will not have sufficient biomass to produce a decent yield, as the plant will flower after June 21 regardless of the size of the plant.

Rotational Considerations

Hemp is a broadleaf oilseed and fibre crop. It is susceptible to similar diseases and insect pests that affect other oilseed crops, such as canola, and should be grown in rotation with cereal and forage crops. However, avoid seeding hemp on wheat, spice crops, and buckwheat stubble. Wheat and buckwheat seed are difficult to clean out of hemp seed, while spice and herb crops may introduce unfavourable flavours to hemp oil. Hemp does well on fields previously under alfalfa, or on green manured fields where fertility is high and weeds are under control. In drier areas, seeding hemp on fallow provides better weed control, soil moisture and fertility. Pedigree seed must be used. Volunteer hemp plants that emerge in other crops during the rotation must be destroyed. It is not recommended to grow hemp on hemp stubble.

Perennial weeds should be controlled in the year previous to hemp production, and some herbicide soil residues may cause crop injury (example: ODYSSEY, ABSOLUTE, PURSUIT, ALLY, ASSERT, MUSTER, PRISM, ESCORT, EVEREST, UNITY, CURTAIL M, FLAXMAX, LONTREL, PRESTIGE, ACCENT, ATRAZINE, LADDOK, PRIMEXTRA, SHOTGUN, ATTAIN, TROPHY, FRONTLINE, SPECTRUM, PREPASS, SUNDANCE, SENCOR, EDGE, TRIFLURALIN, FRONTIER). See "Recropping Restrictions for Residual Herbicides" chart in the Guide to Crop Protection (http://www.agr.gov.sk.ca/Docs/crops/cropguide00.asp)

Varieties

Tall varieties are better suited to fibre production, while shorter varieties are better suited for grain production. Finola, USO 14, USO 31 and Crag are the most common grain varieties grown in Saskatchewan and also account for 90 to 95 percent of hemp production in Canada. Another variety, Fasamo, is grown but seed supply is limited. Alyssa, developed in Manitoba, was registered in 2004 for dual purpose – grain and fibre.

Commercial hemp cultivation licenses are only issued for pedigreed seed of varieties listed in the Health Canada List of Approved Cultivars. This list is available from the Health Canada website (See Additional Information).

Seeding

The recommended seeding rate for hemp grain production in Saskatchewan is approximately 22 to 34 kg/ha (20 to 30 lb./ac.) depending on variety. Finola is seeded at a higher rate of 34 kg/ha (30 lb./ac.) while USO 14, USO 31 and Crag are seeded at the lower rate of 22 kg/ha (20 lb./ac.). The intended plant density is 100 to 125 plants/m^2 (10 – 12 plants/$ft.^2$). The recommended seeding rate for hemp fibre production is 67 kg/ha (60 lb./ac.) or approximately 300 to 375 plants/m^2 (30 – 35 plants/ft^2). The higher seeding rate for fibre is due to the need for many fine stems with a higher percentage of fibre in the stems. On average, the bushel weight of hemp seed is 44 pounds. According to data from Manitoba, thousand kernel weights of the current varieties are: USO 14 = 16 g, USO 31 = 18 g, Alyssa = 18 g and Finola = 12 g. Based on 2005 prices, seed costs range from $74 to $160/ha ($30 to $65/ac.) depending on variety.

Hemp can be seeded with any conventional seeding equipment. However, care must be taken if seeding is done by an air seeder. The lowest amount of air that allows delivery of seed without plugging should be used. The seed is high in oil, and if the air flow is set too high, some of the seeds will be cracked on the divider manifold. The recommended seeding depth is approximately one to two centimetres (½ - 1 in.). Seed should be placed as shallow as possible, but into moist soil. Packing is necessary to allow for good seed-soil contact, but do not pack too tightly as excess soil compaction will reduce emergence. Soil compaction due to heavy rainfall after planting can significantly reduce plant emergence.

Optimum soil temperature for fast germination and emergence is eight to 10°C. Hemp should be seeded in Saskatchewan between May 1 and May 31.

Fertilization

Research data on soil fertility is limited. Results so far indicate that hemp may require total nutrient levels (field plus fertilizer nutrients) similar to a high yielding wheat crop, approximately 100 kg N/ha (90 lb. N/ac.); 50 kg P_2O_5/ha (45 lb. P_2O_5/ac.); 67 kg K_2O/ha (60 lb. K_2O/ac.) and 17 kg S/ha (15 lb. S/ac.). Soil testing to determine soil nutrient levels is recommended. Recent research at Agriculture and Agri-Food Canada's (AAFC) research station in Melfort showed increases in seed yield, biomass, plant height, and protein content were achieved as nitrogen fertilizer was increased up to 120 kg/ha (107 lb./ac.). Nitrogen is best side-banded, mid-row-banded or banded in a separate operation, as hemp seed may be sensitive to seed-placed N fertilizer. Excess rates of N can negatively affect fibre quality.

The study at Melfort (AAFC) also showed that hemp seed may be sensitive to seed-placed phosphate fertilizer under drier conditions. In this study, plant stand and biomass yield declined when P was seed-placed at 22 kg P_2O_5/ha (20 lb. P_2O_5/ac.). Starter phosphate rates should be kept low 11-17 kg P_2O_5/ha (10–15 lb. P_2O_5/ac.). Any additional phosphate needed to correct a deficiency should be side-banded or mid-row-banded. If potassium or sulphur is required as indicated by the soil test, these nutrients should be side-banded or mid-row-banded.

Hemp responds well to fields with previous manure application. Organic production should occur in fertile fields, such as after green manuring with legumes.

Weed Control

There are no herbicides registered for use in hemp in western Canada. Management of weeds is very important in the early stages of hemp crop development. A uniform crop stand that emerges ahead of weeds is important. Field selection, tillage, and good soil moisture-to-seed contact after seeding assist in quick crop emergence.

After the crop stand is established, hemp becomes a strong competitor with weeds. Wild buckwheat can be a major weed problem, as it grows up the stem and produces seed at the same height as the hemp seed. Furthermore, wild buckwheat seed is difficult to separate from hemp seed. Perennial weed control should be undertaken in the year prior to seeding hemp. There are no pre-harvest herbicides registered for use in hemp.

Volunteer hemp control

Hemp regulations require the elimination of all volunteer plants. Several herbicides used in cereal grains have activity on hemp, although none are registered for that use. Glyphosate products would be suitable for pre-seeding applications. The use of in-crop broadleaf weed herbicide with some residual activity may minimize volunteer problems. Cultivation can be used to control hemp in fallow situations, but several passes may be necessary.

Extreme care must be taken to avoid contamination of grain of subsequent crops with the seeds of volunteer hemp, as this will lead to the rejection of shipments in some countries.

Disease Control

There are no fungicides registered for use in hemp. Common seedling root rots and leaf spot diseases are likely to kill some hemp seedlings, especially in years with excess precipitation. Experience with hemp production indicates sclerotinia (*Sclerotinia sclerotiorum*) stem and root rot can be a significant problem. Producers should avoid a close crop rotation of hemp with other crops susceptible to sclerotinia, such as canola, mustard, sunflower, pea, and dry bean. Botrytis (*Botrytis cinerea*) grey mold can infect hemp flowers and seed development if high moisture conditions persist during flowering.

Insect Control

There are no insecticides registered for use in hemp. Grasshoppers and Bertha armyworm can cause significant damage to the hemp crop. Painted Lady Butterfly build nests in hemp, but do not seem to pose a serious threat to the crop. Cutworms and European corn borer

have been reported on hemp. Sucking insects such as aphids, stink bugs and lygus plant bugs have been known to feed on hemp. They can cause yield reduction and can be disease vectors. However, no serious infestations of sucking insects on hemp have been reported in Saskatchewan.

Other Concerns

Hail and strong winds can cause damage to hemp, especially in early stages when the stalks are not yet strong enough. Depending on the stage at which damage occurred, hemp plants may try to recover from the damage by "goose necking" from the kinks or developing new branches from auxiliary buds, but potential yields may not be reached. Also, recovering plants may not reach the general crop height, resulting in failure to capture the heads during harvesting.

Water-logged symptoms.
Courtesy of MAFRI

Persistent water-logged conditions resulting from prolonged and excessive rainfall are detrimental to hemp development. Plants may turn yellow, cease to grow and may eventually die.

Black birds have caused significant grain loss to mature hemp plants in areas near lakes and sloughs. Wind and hail damage can also be a problem in tall crops due to bent and broken stems.

THC Sampling and Analysis

As part of the license requirements for growing hemp, producers must provide proof that their hemp crop has a THC level of less than 0.3 per cent. This is accomplished by hiring the services of a person approved by Health Canada as a hemp sampler. A list of approved samplers is available from the Health Canada website (see Additional Information). Variety USO 31, which has consistently shown THC levels far below the required maximum, has been exempted from annual sampling and testing in all regions of Canada.

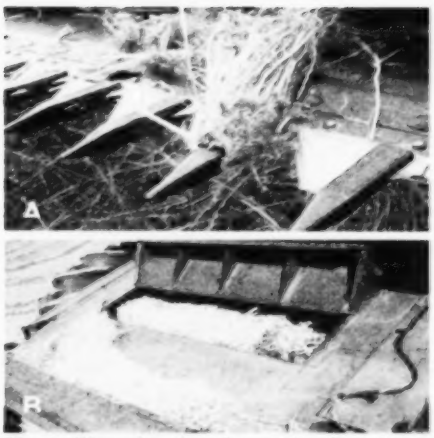
The sampler must follow the Health Canada guidelines outlined in the Industrial Hemp Technical Manual to collect samples, dry them and submit the samples to an approved laboratory for analysis. The laboratory analysis determines the level of THC found in the crop sample and provides a report to the grower. The form for *Reporting of Results of Delta-9 THC Testing of Industrial Hemp* is also available from the Heath Canada website.

A copy of the report must be submitted to Health Canada to be in compliance with the cultivation license. The grower must pay for both the sampling and laboratory analysis. In 2005, the cost of sampling and analysis ranged from $260 to $300 per field.

Harvesting

Fibre: Hemp grown for fibre should be harvested at early to mid-flowering stage utilizing specialized equipment. Contracting companies will advise growers regarding the best approach for harvesting fibre crops.

Grain: Harvesting hemp is a big challenge. Straight combining has been shown to be preferable to swathing for most hemp varieties, due to reduced fibre intake. According to studies conducted by Hemp Oil Canada Inc., typically only Finola lends itself well to swathing and only under certain conditions – smaller stature crop (low biomass) and dry weather. If swathing is the only method available, cut at 85 per cent maturity or earlier if shattering is noticed. The more hemp matures and dries the tougher the fibres become, and the more difficult it is to cut and thresh the crop. Ensure that the forecast is for dry weather while the crop is in the swath, as hemp does not dry well in the swath if rained upon, and the seed may start sprouting. Studies by Hemp Oil Canada Inc. also showed that certain combine models can handle large volumes of material in the swath (20+ bu./ac. crop) much better than others without any modifications. Ensure that new or sharpened sickle and guards are used to cut the crop, and that the combine can handle swathed hemp. Failure to use proper equipment, over-feeding the combine, or poor harvest timing may lead to problems of plugging during harvest.



Hemp fibre clogging the cutting bar (A) and combine paddles (B, swathed).

Straight combining is done prior to seed shattering, and normally when the grain is at 12 to 20 per cent moisture, depending on variety. Finola is often harvested at 12 to 14 per cent, but may be harvested up to 20 per cent moisture content. Crag, USO 14 and USO 31 are usually harvested at approximately 20 per cent seed moisture. However, waiting for the crop to ripen and dry down to lower moisture content may increase the risk of fibres wrapping around moving combine parts, increasing the risk of fire. Drier seeds are also susceptible to cracking, resulting in oxidation and rancidity. Aerate immediately after combining to reduce the seed moisture content to less than nine per cent for safe storage and preservation of grain quality.

Growers report that crops over 2.5 m (eight ft.) in height are very difficult to harvest. The header should be operated as high as possible to minimize the amount of stalks entering the combine. Overloading the combine should be avoided to reduce wrapping. Do not attempt to use the straw chopper due to fibre wrapping. Cylinder speed should be slowed to approximately 350 rpm, and a slow ground speed is required. Damage to the seed hull (i.e. cracking) in the combine should be avoided to reduce spoilage during storage.

Combine fires are a risk, due to fibres wrapping around moving parts and fine dust igniting on hot surfaces. It is important to frequently monitor moving parts for wrapped fibre, and keep hot engine surfaces clean. The remaining stalks can be cut with a narrow swather or haybine, baled, and stored for potential sale as a source of low quality hemp fibre. The stubble should be cut as soon as possible after combining before the stalks become too rigid to handle properly.

Grain yields have varied from 250 to 2,200 kg/ha (five-45 bu./ac.) in Saskatchewan depending on growing conditions. Typical grain yields in Saskatchewan are 740 to 1,200 kg/ha (15-25 bu./ac.).

Hemp regulations require that all harvesting equipment be thoroughly cleaned before leaving the licensed hemp field.

Storage and Handling

Hemp regulations require the crop to be stored in a secure and suitable location which only authorized persons can access.

Hemp is an oilseed crop, and must be stored in a similar method to other oilseeds to avoid spoilage. Grain may be harvested as high as 20 per cent moisture, but must be dried to less than nine per cent moisture for safe storage.

Drying using aeration fans should begin immediately after harvest. Once aeration commences, the fan should not be turned off until the grain is dry. Hemp grain dries relatively easily, provided the sample is free of green weed seeds and plant material, and darkens as it dries. The use of supplemental heat drying has not been tested, and maximum drying temperatures are not known at this time.

A hemp moisture conversion chart for moisture metres is available from the Canadian Grain Commission (see Additional Information).

The following procedure can also be used to determine seed moisture content: weigh 100 g of seed and place it in a microwave for 30-second intervals, weighing the seeds between each interval. Repeat until the seed weight becomes constant after three intervals.

Per cent seed moisture content equals

$$\frac{100\ g - \text{weight of seed after drying (g)} \times 100}{\text{weight of seed after drying (g)}}$$

Grain augers should be operated full and at slow speeds to reduce dehulling and splitting of seed. Hemp grain must be cleaned to food processing standards. Seeds with floral bracts still attached and flower and leaf parts remaining in the sample can be a concern, because they may contain higher levels of THC. THC contamination of oil to levels above legal limits could lead to rejection of the product.

Mature hemp seeds have dark markings. Frozen or immature seeds have a colourless seed coat, and must be removed in the cleaning process and destroyed.

Retting of Stalks

The process of beginning the separation of the bast fibres from the hurd in hemp stalks is called ***retting***. Retting can be done in the field using moisture and sun, or in tanks with treatments of water or chemicals. Field retting in Saskatchewan has not been proven reliable due to dry environmental conditions after harvest. Industrial processes using water or chemicals to ret hemp stalks in an environmentally acceptable manner have not been developed.

Economics of Production

Cost of production and expected returns under Saskatchewan conditions have not been calculated in detail. Typical cost of production in Saskatchewan ranges from $370-$490/ha ($150-$200/ac.). At current prices, the break-even yields for conventional and organic hemp production are 10 bu./ac. and five bu./ac. respectively.

Additional Information:

Health Canada
Industrial Hemp Regulation Program
Office of Controlled Substances, Therapeutic Products Program
Health Protection Branch
Address Locator: 3618B
Ottawa, ON, Canada, K1A 1B9
Phone: (613) 954-6524
Fax: (613) 941-5360
http://www.hc-sc.gc.ca/dhp-mps/substancontrol/compli-conform/applic-demande/index_e.html

Saskatchewan Agriculture and Food (SAF)
Visit www.agr.gov.sk.ca under Crops | Special Crops | Production Information
Call the Agriculture Knowledge Centre at
1-866-457-2377

Saskatchewan Hemp Association (SHA)
Visit www.saskhemp.com or www.hemptrade.ca
P.O. Box 24007
Regina SK S4P 4J8
Phone: 1-306 757-4367
Fax: 1- 306 757-4365
E-mail: hcfr@sasktel.net

Other sources of information:
Alberta Agriculture, Food and Rural Development:
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex126

Manitoba Agriculture, Food and Rural Initiatives (MAFRI):
http://www.gov.mb.ca/agriculture/crops/hemp/bko01s00.html

Ontario Ministry of Agriculture, Food and Rural Affairs:
http://www.omafra.gov.on.ca/english/crops/hort/hemp.html

Canadian Grain Commission
http://www.grainscanada.gc.ca

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Revised April 2006